

Department of the Interior
U.S. Geological Survey

**LANDSAT 5 (L5) INTERNATIONAL GROUND
STATIONS (IGS) INTERFACE CONTROL DOCUMENT
(ICD)**

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LANDSAT 5 (L5) INTERNATIONAL GROUND STATIONS (IGS) INTERFACE CONTROL DOCUMENT (ICD)

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Section 1 Introduction

1.1 Scope

This Interface Control Document (ICD) establishes and records the requirements and communications protocol for scheduling image data downlinks from the Landsat 5 (L5) satellite.

1.2 Purpose

The purpose of this ICD is to outline the downlink planning process and to specify the format and content of the various messages exchanged among the U.S. Geological Survey (USGS), the L5 Mission Operations Center (MOC), and the International Ground Station (IGS) for scheduling and implementing the image data downlinks from the L5 satellite.

1.3 Applicability

The requirements specified in this ICD shall be in effect for the operational period defined in the Service Agreement between USGS and the IGS for the downlink of image data from the L5 satellite.

Section 2 Interface Requirements

2.1 Scheduling Timeline

2.1.1 Weekly Timeline

Figure 3-1 shows the weekly timeline established for successfully and routinely scheduling the image data downlink from the L5 satellite. Messages containing the information specified herein shall be exchanged between the USGS, the L5 Scheduling Department, and the IGS, as illustrated in the weekly timeline.

2.1.2 Emergency Timeline

Figure 3-2 shows the emergency timeline established for successfully scheduling the image data downlink from the L5 satellite. Requests for acquisition are not accepted within two days of the planned acquisition. Messages containing the information specified herein shall be exchanged between the USGS Flight Operations System Manager, the L5 Scheduling Department, and the IGS, as illustrated in the emergency timeline.

2.2 Operational Interface Requirements

2.2.1 Service Request Message

The Service Request Message (SRVREQ) shall be used to request the acquisition and transmission of all image data to the IGS. This message shall be in the format described in Figure 3-3 and defined in Table 3-1. The USGS Flight Operations System Manager and the L5 Scheduling Department shall receive the service request message no later than eleven (11) days prior to the acquisition day.

2.2.2 Service Schedule Message

The L5 Scheduling Department shall use the Service Schedule Message (SRVSCH) to schedule the acquisition and transmission of all image data to the IGS. This message shall be in the format described in Figure 3-4 and defined in Table 3-2. The first service schedule message shall be transmitted by the L5 MOC to the IGS at least three (3) days prior to the first day of the target week. The service schedule message contains all image acquisition for the IGS covering a period of three (3) days. The L5 MOC may transmit subsequent service schedules, two (2) and one (1) day prior to the acquisition date.

2.2.3 Spacecraft Orbital Elements

The L5 MOC shall provide spacecraft orbital elements to the IGS for spacecraft tracking. Spacecraft elements are available in the NORAD 2-line element (NORAD) format, the Improved Inter-Range Vector format (IIRV), and Short Form Brouwer Mean Element format (SFBME). The L5 MOC shall transmit the orbital elements to the IGS daily. The epoch of the orbital elements represents the start of the orbit determination that was used to generate the elements. All orbital element messages shall contain spacecraft position and velocity vectors for the given epoch. The NORAD, IIRV, and SFBME shall be in the format described in Figure 3-5, Figure 3-6, and Figure 3-7, respectively. These formats are defined in Table 3-3, Table 3-4, and Table 3-5, respectively.

2.2.4 Definitive Ephemeris (DE)

The Definitive Ephemeris (DE) files contain the satellite position information at one-minute intervals for a 61-hour period. The L5 processing systems use the DE information for Level 1 geometric correction processing. MDS will FTP transfer the DE from the L5 MOC daily. The following tables show an example and describe the format and content of the DE file.

The DE files that the L5 MOC distributes are generated daily after the completion of the orbit determination processing. The DE files are placed on the L5 MOC server for pickup by the L5 Ground Stations. The L5 MOC cleans up all files on the L5 MOC server that are 30 days or older. Figure 3-8 shows a sample DE file, and Table 3-12 defines the formats.

The file naming convention for the DE report file pulled from the L5 MOC for the MDS is:

L5yyyydddDEFEPH.Snn

Where: L5 = constant for Landsat 5
 yyyy = 4-digit year of file creation
 ddd = 3-digit day of year of file creation
 DEFEPH = 6-letter file type identifying this file (Definitive Ephemeris)
 .Snn = sequence number of the file type for this day of creation

The DE file contains three (3) header lines followed by 3660 lines of DE points. The nominal daily file has an end time of 1300Z on the day of creation, and a start time 61 hours earlier than that, 0000Z two days earlier. For example, the file generated on day 38 covers from day 36/0000Z through 38/1300Z.

Section 3 Notes

3.1 Communications

The L5 MOC supports the following communications methods: phone, fax, FTP, and e-mail. The IGS must send an e-mail to the L5 Scheduling Department that lists which of the four communication methods is to be used to communicate with the IGS. Table 3-13 lists the communications addresses, personnel points of contact, office hours, and areas of responsibility.

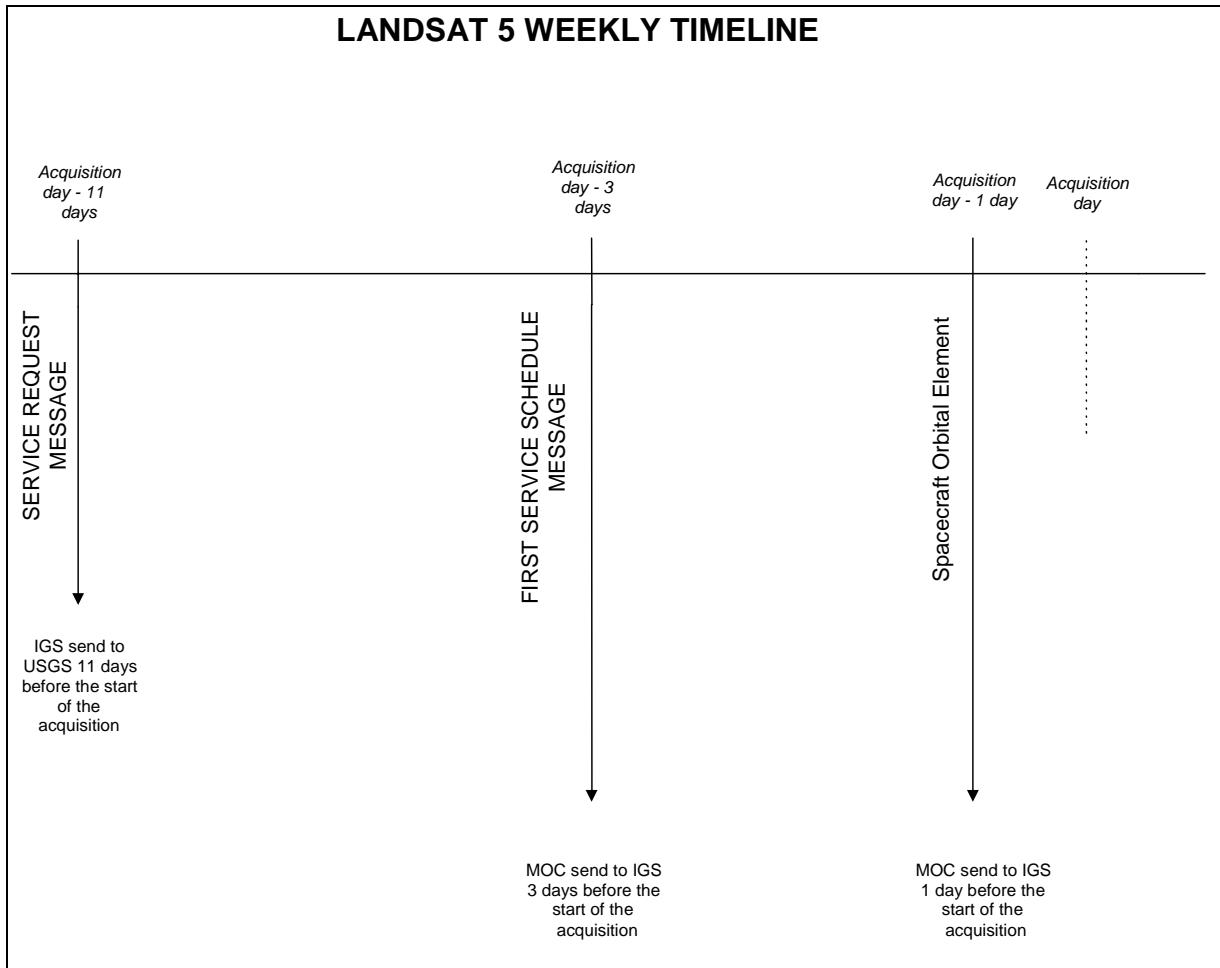


Figure 3-1. L5 Weekly Timeline

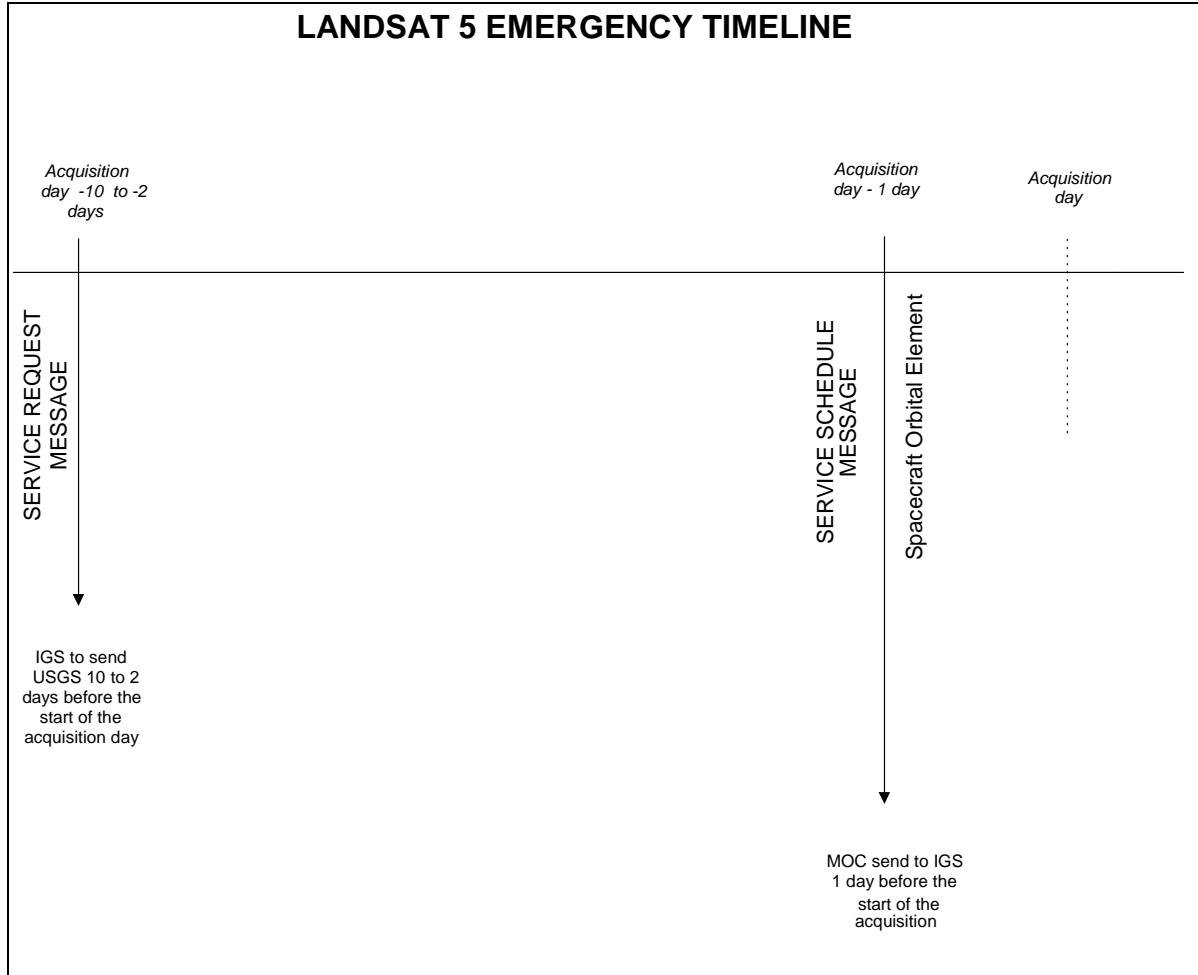


Figure 3-2. L5 Emergency Timeline

DEST: LAM
ATTN: MISSION PLANNING
ORIG: XXX
FROM: AAAAAAAAAAAAAAAA
TYPE: SRVREQ
DTG: dd-mmm-yyyy hh:mm:ss
SEQ: nnn

DATE	S/C	PATH	START	STOP	SENSOR	TARGET LATITUDE
TARGET LONGITUDE						
dd-mmm-yyyy	LS5	nnn	ROW nnn	ROW nnn	TM	deg*mn'sc.nn" A
deg*mn'sc.nn" B						

TEXTEND:

Figure 3-3. Service Request Message Format

LINE	COLUMN	ITEM	DESCRIPTION	DEFINITION
1	1-5	keyword	DEST:	Destination field
1	7-9	value	LAM	Designator for L5 in Lanham, MD
2	1-5	keyword	ATTN:	Attention field
2	7-22	value	MISSIONbPLANNING	Message recipient
3	1-5	keyword	ORIG:	Originator field
3	7-9	value	XXX	Where XXX = IGS CODE
4	1-5	keyword	FROM:	From field
4	7-27	value	21 character free-form	Department responsible for generating message
5	1-5	keyword	TYPE:	Message Type field
5	7-12	value	SRVREQ	Message type for service request
6	1-4	keyword	DTG:	Date-Time-Group field
6	7-29	value	dd-mmm-yyyyhh:mm:ss.ss	Where dd = 01 to 31 mmm = JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC yyyy = 2003-2010 hh = 00 to 23 mm = 00 to 59 ss.ss = 00.00 to 59.99
7	1-4	keyword	SEQ:	Sequence number field
7	7-9	value	nnn	Where nnn = 001 to 999
8	1-4	keyword	DATE	Date field
8	17-19	keyword	S/C	Satellite identification field
8	24-27	keyword	PATH	Flight path field
8	32-36	keyword	START	Start row field
8	41-44	keyword	STOP	Stop row field

Table 3-1. Service Request Message Format Definition (1 of 2)

LINE	COLUMN	ITEM	DESCRIPTION	DEFINITION
8	48-53	keyword	SENSOR	Payload sensor field
8	57-72	keyword	TARGET b LATITUDE	Latitude coordinate of the target field
8	81-96	keyword	TARGET b LONGITUDE	Longitude coordinate of the target field
9	32-34	keyword	ROW	Start row field
9	41-43	keyword	ROW	Stop row field
10-n	1-11	value	dd-mmm-yyyy	Acquisition date where dd = 01 to 31 mmm = JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC yyyy = 2003 - 2010
10-n	17-19	value	LS5	Satellite identification
10-n	24-26	value	nnn	Flight path where nnn = 001 to 233
10-n	32-34	value	nnn	Start row where nnn = 001 to 248
10-n	41-43	value	nnn	Stop row where nnn = 001 to 248
10-n	48-49	value	TM	Payload sensor
10-n	57-71	value	deg*mn ' sc.nn" b A	Target latitude where deg = 000 to 180 mn = 00 to 59 sc = 00 to 59 nn = 00 to 99 A = N (North) or S (South)
10-n	81-95	value	deg*mn ' sc.nn" b B	Target longitude where deg = 000 to 180 mn = 00 to 59 sc = 00 to 59 nn = 00 to 99 B = E (East) or W (West)
n+1	1-8	keyword	TEXTEND:	Signifies the end of the message

b = blank

Table 3-2. Service Request Message Format Definition (2 of 2)

```
ZCZCUS 6ddd.nnn AKU
*
DEST: ddd
ATTN: A21
ORIG: LAM
FROM: Operations
TYPE: SRVSCH
DTG: dd-mmm-yyyy hh:mm:ss
SEQ: nnn
AAA 5 d1-mmm-yyyy hh:mm:ss d2-mmm-yyyy hh:mm:ss SSSS OOOOO PPP +0.0
TEXTEND:
```

Figure 3-4. Service Schedule Message Format

LINE	COLUMN	ITEM	DESCRIPTION	DEFINITION
1	1-19	keyword	ZCZCUSb6ddd.nnnbAKU	Commercial carrier tracking code Where ddd = IGS CODE Where nnn = 001 to 999
2	1	keyword	*	
3	1-5	keyword	DEST:	Destination field
3	7-9	value	ddd	Where ddd = IGS CODE
4	1-5	keyword	ATTN:	Attention field
4	7-27	value	21 character free form	Message recipient
5	1-5	keyword	ORIG:	Originator field
5	7-9	value	LAM	The designator for L5 in Lanham, Md.
6	1-5	keyword	FROM:	From field
6	7-22	value	Operations	Department responsible for generating message.
7	1-5	keyword	TYPE:	Message Type field
7	7-12	value	SRVSCH	Message type for service schedule
8	1-4	keyword	DTG:	Date-Time-Group field
8	7-29	value	dd-mmm- yyyyhh:mm:ss.ss	Where dd = 01 to 31 mmm = JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC yyyy = 2003-2010 hh = 00 to 23 mm = 00 to 59 ss.ss = 00.00 to 59.99
9	1-4	keyword	SEQ:	Sequence number field. Increments by one as a new message generates.
9	7-9	value	nnn	Where nnn = 001 to 999

b = blank

Table 3-3. Service Schedule Message Format Definition (1 of 2)

LINE	COLUMN	ITEM	DESCRIPTION	DEFINITION
10-n	1-3	value	AAA	Receiving station Where AAA = IGS CODE
10-n	5	value	5	Spacecraft ID
10-n	7-26	value	d1-mmm-yyyy <u>b</u> hh:mm:ss	Payload On time Where d1 = 01 to 31 mmm = JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC yyyy = 2003-2010 hh = 00 to 23 mm = 00 to 59 ss = 00 to 59
10-n	28-47	value	d2-mmm-yyyy <u>b</u> hh:mm:ss	Payload Off time Where d2 = 01 to 31 mmm = JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC yyyy = 2003-2010 hh = 00 to 23 mm = 00 to 59 ss = 00 to 59
10-n	49-52	value	SSSS	Sensor Where SSSS = TM <u>bb</u>
10-n	54-58	value	OOOOO	Orbit number Where OOOOO = 00001 to 99999
10-n	60-62	value	PPP	Path number Where PPP = 001 to 233
10-n	64-67	value	+0.0	Pan tilt angle
n+1	1-8	keyword	TEXTEND:	Field signifying the end of the message

b = blank

Table 3-4. Service Schedule Message Format Definition (2 of 2)

ZCZCUS 6ddd.nnn AKU
*
DEST: ddd
ATTN: STATION OPERATOR
ORIG: LAM
FROM: Operations
TYPE: NORAD
DTG: dd-mmm-yyyy hh:mm:ss
SEQ: nnn
1 14780U 84021A yyddd.fffffff sfffffff smmmmm-m sbffff-b 0 eeeeec
2 14780 iii.iiii raa.aaaa eeeeeee ppp.pppp mmm.mmmm rr.rrrrrrrrrooooooc
TEXTEND:

Figure 3-5. Norad Two Line Elements Message Format

DEST: ddd
ATTN: STATION OPERATOR
ORIG: LAM
FROM: Operations
TYPE: IIRV
DTG: dd-mmm-yyyy hh:mm:ss
SEQ: nnn
Landsat 5 IIRV from EOSAT
GIIRV MANY
0011141901sssdoyhmmsssscsrm
axxxxxxxxxxxsyyyyyyyyyysszzzzzzzzzcsrm
axxxxxxxxxxxsyyyyyyyyyysszzzzzzzzzcsrm
mmmmmmmmmaaaaakkkksrrrrrrrcsm
ITERM
TEXTEND:

Figure 3-6. IIRV Message Format

DEST: IGS
ATTN: STATION OPERATOR
ORIG: LAM
FROM: Operations
TYPE: SFBME
DTG: dd-mmm-yyyy hh:mm:ss
SEQ: nnn
LNDSAT-5 8402101 E yyymmdd. hhmmss.sss
smx xxxx.xxxx ecc e.eeeeeeee inc ii.iiii rAA rr.rrrr
LnA' l.1111 Arp aaa.aaaa Arp' sa.aaaa Man mmm.mmmm
P pp.pppp pht hhh.hhhh aht aaa.aaaa
vp p.pppp va v.vvvv Ltp s11.1111
eLn eee.eeee gLt gg.gggg ht hhh.hhhh
x sxxxx.xxxxxxxx y syyyy.yyyyyyyy z szzzz.zzzzzzzz
x' sx.xxxxxxxx y' sy.yyyyyyyy z' sz.zzzzzzzz
TEXTEND:

Figure 3-7. SFBME Message Format

```

"Start", "Stop"
203/2003 00:00:00.000,205/2003 13:00:00.000
"Time (UTCJ4)","x (km)","y (km)","z (km)","vx (km/sec)","vy (km/sec)","vz (km/sec)"
203/2003 00:00:00.000,-390.604783,-7067.425640,-257.986198,-1.089600,-0.203477,7.421541
203/2003 00:01:00.000,-455.147048,-7065.340824,187.528259,-1.061083,0.272963,7.423923
203/2003 00:02:00.000,-517.848814,-7034.690557,632.282547,-1.028270,0.748380,7.396209
203/2003 00:03:00.000,-578.456221,-6975.594570,1074.473366,-0.991295,1.220830,7.338502
203/2003 00:04:00.000,-636.723927,-6888.288951,1512.307509,-0.950307,1.688381,7.251035
203/2003 00:05:00.000,-692.416122,-6773.125111,1944.009383,-0.905474,2.149121,7.134163
203/2003 00:06:00.000,-745.307495,-6630.568273,2367.828385,-0.856978,2.601170,6.988362
203/2003 00:07:00.000,-795.184188,-6461.195507,2782.046175,-0.805018,3.042681,6.814232
203/2003 00:08:00.000,-841.844663,-6265.693263,3184.983824,-0.749807,3.471857,6.612486
203/2003 00:09:00.000,-885.100506,-6044.854430,3575.008743,-0.691569,3.886948,6.383955
203/2003 00:10:00.000,-924.777187,-5799.574979,3950.541398,-0.630542,4.286268,6.129576
203/2003 00:11:00.000,-960.714786,-5530.850176,4310.061811,-0.566976,4.668196,5.850396
...
205/2003 12:53:00.000,0.0,0.0,0.0,0.0,0.0,0.0
205/2003 12:54:00.000,226.953788,-6686.194654,-2331.592223,-1.055878,-2.472531,7.002558
205/2003 12:55:00.000,163.185799,-6820.950871,-1907.003325,-1.069007,-2.017803,7.145638
205/2003 12:56:00.000,98.759231,-6928.164703,-1474.693408,-1.077823,-1.554762,7.259834
205/2003 12:57:00.000,33.934082,-7007.393738,-1036.410761,-1.082288,-1.085293,7.344658
205/2003 12:58:00.000,-31.027848,-7058.309456,-593.929248,-1.082381,-0.611306,7.399746
205/2003 12:59:00.000,-95.864090,-7080.698750,-149.040869,-1.078099,-0.134735,7.424857
205/2003 13:00:00.000,-160.312589,-7074.464875,296.451640,-1.069460,0.342475,7.419875

```

Figure 3-8. Definitive Ephemeris Example

LINE	COLUMN	ITEM	DESCRIPTION	DEFINITION
1	1-19	keyword	ZCZCUSb6ddd.nnnbAKU	Commercial carrier tracking code Where ddd = IGS CODE Where nnn = 001 to 999
2	1	keyword	*	
3	1-5	keyword	DEST:	Destination field
3	7-9	value	ddd	Where ddd = IGS CODE
4	1-5	keyword	ATTN:	Attention field
4	7-22	value	STATIONbOPERATOR	Message recipient
5	1-5	keyword	ORIG:	Originator field
5	7-9	value	LAM	The designator for L5 in Lanham, MD.
6	1-5	keyword	FROM:	From field
6	7-16	value	Operations	Department responsible for generating message.
7	1-5	keyword	TYPE:	Message Type field
7	7-11	value	NORAD	Message type for NORAD 2-line element
8	1-4	keyword	DTG:	Date-Time-Group field
8	7-29	value	dd-mmm-yyyybhh:mm:ss.ss	Where dd = 01 to 31 mmm = JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC yyyy = 0000 to 9999 hh = 00 to 23 mm = 00 to 59 ss.ss = 00.00 to 59.99
9	1-4	keyword	SEQ:	Sequence number field
9	7-9	value	nnn	Where nnn = 001 to 999
10	1	value	1	line number
10	3-7	value	14780	NORAD satellite ID
10	8	value	U	U = Unclassified mission
10	10-15	value	84021A	International designator

b = blank

Table 3-5. Norad Two Line Element Format Definition (1 of 2)

LINE	COLUMN	ITEM	DESCRIPTION	DEFINITION
10	19-32	value	yyddd.fffffff	epoch of the element where yy = last two digits of year (00 to 99) ddd = Julian day (001 to 366) fffffff = fraction of day (00000000 to 99999999)
10	34-43	value	sfffffff	First derivative of mean motion Where s = blank if positive, – if negative
10	45-52	value	smmmmm-m	Second derivative of mean motion Where s = blank if positive, – if negative Decimal point is assumed, usually zero-filled
10	54-61	value	sbbbb-b	BSTAR drag term Where s = blank if positive, – if negative Decimal point is assumed
10	63	value	0	Mean inertial ephemeris
10	65-68	value	eeee	element number (0001 to 9999)
10	69	value	c	line checksum where c = 0 to 9 (modulo 10)
11	1	value	2	line number
11	3-7	value	14780	NORAD satellite ID
11	9-16	value	iii.iiii	inclination in degrees where iii.iiii = 098.0000 to 098.5000
11	18-25	value	raa.aaaa	right ascension of ascending node where raa.aaaa = 000.0000 to 360.0000
11	27-33	value	eeeeeee	Eccentricity (assumed decimal at left)
11	35-42	value	ppp.pppp	Argument of perigee in degrees Where ppp.pppp = 075.0000 to 100.0000
11	44-51	value	mmm.mmmm	Mean anomaly in degrees Where mmm.mmmm = 000.0000 to 360.0000
11	53-63	value	rr.rrrrrrr	Mean motion (revolutions per day) Where rr.rrrrrrr = 00.00000000 to 99.99999999
11	64-68	value	ooooo	orbit number at epoch where ooooo = 00001 to 99999
11	69	value	c	line checksum where c = 0 to 9 (modulo 10)
12	1-8	keywrd	TEXTEND:	Field signifying the end of the message

b = blank

Table 3-6. Norad Two Line Element Format Definition (2 of 2)

LINE	COLUMN	ITEM	DESCRIPTION	DEFINITION
1	1-5	keyword	DEST:	Destination field
1	7-9	value	ddd	Where ddd = IGS CODE
2	1-5	keyword	ATTN:	Attention field
2	7-22	value	STATIONbOPERATOR	Message recipient
3	1-5	keyword	ORIG:	Originator field
3	7-9	value	LAM	The designator for L5 in Lanham, MD.
4	1-5	keyword	FROM:	From field
4	7-16	value	Operations	Department responsible for generating message.
5	1-5	keyword	TYPE:	Message Type field
5	7-11	value	NORAD	Message type for NORAD 2-line element
6	1-4	keyword	DTG:	Date-Time-Group field
6	7-29	value	dd-mmm-yyyyhh:mm:ss.ss	Where dd = 01 to 31 mmm = JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC yyyy = 0000 to 9999 hh = 00 to 23 mm = 00 to 59 ss.ss = 00.00 to 59.99
7	1-4	keyword	SEQ:	Sequence number field
7	7-9	value	nnn	Where nnn = 001 to 999
8	1-25	keyword	Landsat 5bIIRVbfrombEOSAT	Orbital Element Description
9	1-5	keyword	GIIRV	Message start
9	7-10	keyword	MANY	Routing indicator (multiple destinations)
10	1	value	0	Vector type (free flight, routine on-orbit)
10	2	value	0	Data source (nominal/planning)
10	3	value	1	Transfer type (Interrange)
10	4	value	1	Coordinate system (Geocentric true-of-date rotation)

b = blank

Table 3-7. IIRV Format Definition (1 of 3)

LINE	COLUMN	ITEM	DESCRIPTION	DEFINITION
10	9-10	value	01	Vehicle Identification Code
10	11-13	value	000	Sequence number incremented for each vector in a set of vector data. Fixed for L5
10	14-16	value	doy	Day of year (001 – 366)
10	17-25	value	hhmmsssss	Vector epoch in UTC where hh = 00 – 23 (hours) mm = 00 – 59 (minutes) sssss = 00000 – 59999 (milliseconds – implied decimal is three places from the right)
10	26-28	value	csm	Checksum for line 12; calculated by summing the decimal equivalent of the preceding characters in the line, counting spaces as 0 and negative signs as 1
11	1-13	value	sxxxxxxxxxxxxx	X component of the position vector in meters s = “-“ for negative sign or ASCII space for positive sign
11	14-26	value	syyyyyyyyyyy	Y component of the position vector in meters s = “-“ for negative sign or ASCII space for positive sign
11	27-39	value	szzzzzzzzzzz	Z component of the position vector in meters s = “-“ for negative sign or ASCII space for positive sign
11	40-42	value	csm	Checksum for line 13
12	1-13	value	sxxxxxxxxxxxxx	X component of the velocity vector in meters per second, with a resolution to the nearest millimeter per second; assumed decimal point is three places from the right. a = “-“ for negative sign or ASCII space for positive sign
12	14-26	value	syyyyyyyyyyy	Y component of the velocity vector in meters per second s = “-“ for negative sign or ASCII space for positive sign
12	27-39	value	szzzzzzzzzzz	Z component of the velocity vector in meters per second s = “-“ for negative sign or ASCII space for positive sign

b = blank

Table 3-8. IIRV Format Definition (2 of 3)

LINE	COLUMN	ITEM	DESCRIPTION	DEFINITION
13	1-8	value	mmmmmmmm	Mass of the satellite in kilograms with a resolution to the nearest tenth of a kilogram; assumed decimal point is one place from the right. Must contain all zeros if not used.
13	9-13	value	aaaaaa	Average satellite cross-sectional area in square meters with a resolution to the nearest hundredth of a square meter; assumed decimal point is two places from the right. Must contain all zeros if not used.
13	14-17	value	kkkk	Dimensionless drag coefficient; assumed decimal point is two places from the right. Must contain all zeros if not used
13	18-25	value	srrrrrr	Dimensionless solar reflectivity coefficient; assumed decimal point is six places from the right. Must contain all zeros if not used
13	26-28	value	csm	Checksum for line 15
14	1-5	value	ITERM	Indicates end of message
15	1-8	value	TEXTEND:	End of transmission

b = blank

Table 3-9. IIRV Format Definition (3 of 3)

LINE	COLUMN	ITEM	DESCRIPTION	DEFINITION
1	1-5	keyword	DEST:	Destination field
1	7-9	value	ddd	Where ddd = IGS CODE
2	1-5	keyword	ATTN:	Attention field
2	7-22	value	STATION <u>b</u> OPERATOR	Message recipient
3	1-5	keyword	ORIG:	Originator field
3	7-9	value	LAM	The designator for L5 in Lanham, Md.
4	1-5	keyword	FROM:	From field
4	7-16	value	Operations	Department responsible for generating message.
5	1-5	keyword	TYPE:	Message Type field
5	7-11	value	SFBME	Message type for SFBME
6	1-4	keyword	DTG:	Date-Time-Group field
6	7-29	value	dd-mmm-yyyy <u>b</u> hh:mm:ss.ss	Where dd = 01 to 31 mmm = JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC yyyy = 0000 to 9999 hh = 00 to 23 mm = 00 to 59 ss.ss = 00.00 to 59.99
7	1-4	keyword	SEQ:	Sequence number field
7	7-9	value	nnn	Where nnn = 001 to 999
8	2-9	value	LNDSAT-5	Satellite ID
8	11-17	value	8402101	International designator
8	21-27	value	yymmdd	Time tag
9	2-4	keyword	smx	Semi Major Axis
9	6-14	value	xxxx.xxxx	value
9	16-18	keyword	ecc	Eccentricity
9	20-29	value	e.eeeeeeee	value
9	31-33	keyword	inc	Inclination

b = blank

Table 3-10. SFBME Format Definition (1 of 2)

LINE	COLUMN	ITEM	DESCRIPTION	DEFINITION
9	43-45	keyword	rAA	R.A. of Ascending Node
9	47-53	value	rr.rrrr	value
10	2-5	keyword	LnA'	Longitude of Ascending Node Rate
10	7-12	value	I.IIII	value
10	14-16	keyword	Arp	Argument of Perigee
10	18-25	value	aaa.aaaa	value
10	28-31	keyword	Arp'	Argument of Perigee Rate
10	33-39	value	(+/-)a.aaaa	value
10	41-43	keyword	Man	Mean Anomaly
10	45-52	value	mmm.mmmm	value
11	2	keyword	P	Period
11	4-10	value	pp.pppp	value
11	12-14	keyword	pht	Height of Perifocus
11	16-23	value	hhh.hhhh	value
11	25-27	keyword	aht	Height of Apofocus
11	29-36	value	aaa.aaaa	value
12	2-3	keyword	vp	Velocity at Perigee
12	5-10	value	p.pppp	value
12	12-13	keyword	va	Velocity at Apogee
12	15-20	value	v.vvvv	value
12	22-24	keyword	Ltp	Perigee Latitude
12	26-33	value	(+/-)ll.IIII	value
13	2-4	keyword	eLn	East Longitude
13	6-13	value	eee.eeee	value
13	15-17	keyword	gLt	Geodetic Latitude
13	19-25	value	gg.gggg	Value
13	30-37	value	hhh.hhhh	value
14	2	keyword	x	X Value of Position Vector
14	4-16	value	xxxx.xxxxxxxx	value
14	18	keyword	y	Y Value of Position Vector
14	20-32	value	yyyy.yyyyyyyy	value
14	34	keyword	z	Z Value of Position Vector
14	36-48	value	zzzz.zzzzzzzz	value
15	2-3	keyword	x'	X Value of Velocity Vector
15	5-15	value	(+/-)x.xxxxxxxxx	value
15	18-19	keyword	y'	Y Value of Velocity Vector
15	21-31	value	(+/-)y.yyyyyyyy	value
15	34-35	keyword	z'	Z Value of Velocity Vector
15	37-46	value	(+/-)z.zzzzzzzz	value
16	1-8	keyword	TEXTEND:	Signifies the End of the Message

b = blank

Table 3-11. SFBME Format Definition (2 of 2)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
1	14	"Start","Stop"	Label for time span of product
2		Four fields as described below	
	8	ddd/yyyy Where: ddd = 001 - 366 (three-digit day of year) "/" = separator yyyy = 1999 - 2100 (four-digit year)	Day and year of first ephemeris point in the product
	1	Space	Space between fields
	12	hh:mm:ss.sss Where: hh = 00 - 23 (hour) ":" = separator mm = 00 – 59 (minutes) ":" = separator ss.sss = 00.000 – 59.999 (seconds and thousandths of seconds)	Time of the first ephemeris point in the product
	1	"," = separator	Comma separator between fields
	8	ddd/yyyyb Where ddd = 001 - 366 (3-digit day of year) "/" = separator yyyy = 1999 - 2100 (4-digit year)	Day and year of the last ephemeris point in the product
	1	Space	Space between fields
	12	hh:mm:ss.sss Where: hh = 00 - 23 (hour) ":" = separator mm = 00 – 59 (minutes) ":" = separator ss.sss = 00.000 – 59.999 (seconds and thousandths of seconds)	Time of the last ephemeris point in the product
3		Seven fields, as described below	
	15	"Time (UTCJ4)",	Label for time tag associated with this point
	9	"x (km)",	Label for X-axis position
	9	"x (km)",	Label for Y-axis position
	9	"x (km)",	Label for Z-axis position
	14	"vx (km/sec)",	Label for X-axis velocity
	14	"vx (km/sec)",	Label for Y-axis velocity
	13	"vx (km/sec)"	Label for Z-axis velocity
4 – 3660		Eight fields, as described below	

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
	8	ddd/yyyy Where: ddd = 001 - 366 (3-digit day of year) "/" = separator yyyy = 1999 - 2100 (4-digit year)	Day and year of this ephemeris point
	1	Space	Space between fields
	12	hh:mm:ss.sss Where: hh = 00 - 23 (hour) ":" = separator mm = 00 – 59 (minutes) ":" = separator ss.sss = 00.000 – 59.999 (seconds and thousandths of seconds)	Time of the this ephemeris point
	1	" , " = separator	Comma separator between fields
	10	sNn.nnnnnn Where: s = “-“ for negative value, is omitted for positive value N= 0 – 9 (could be from 0-3 digits long) n.nnnnnn = 0.000000 – 9.999999	X-axis position of this ephemeris point (zero if not available)
	1	" , " = separator	Comma separator between fields
	10	sNn.nnnnnn Where: s = “-“ for negative value, is omitted for positive value N= 0 – 9 (could be from 0-3 digits long) n.nnnnnn = 0.000000 – 9.999999	Y-axis position of this ephemeris point (zero if not available)
	1	" , " = separator	Comma separator between fields
	10	sNn.nnnnnn Where: s = “-“ for negative value, is omitted for positive value N= 0 – 9 (could be from 0-3 digits long) n.nnnnnn = 0.000000 – 9.999999	Z-axis position of this ephemeris point (zero if not available)
	1	" , " = separator	Comma separator between fields

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
	9	sn.nnnnnn Where: s = “-“ for negative value, is omitted for positive value n.nnnnnn = 0.000000 – 9.999999	X-axis velocity of this ephemeris point (zero if not available)
	1	“,” = separator	Comma separator between fields
	9	sn.nnnnnn Where: s = “-“ for negative value, is omitted for positive value n.nnnnnn = 0.000000 – 9.999999	Y-axis velocity of this ephemeris point (zero if not available)
	1	“,” = separator	Comma separator between fields
	9	sn.nnnnnn, Where: s = “-“ for negative value, is omitted for positive value n.nnnnnn = 0.000000 – 9.999999	Z-axis velocity of this ephemeris point (zero if not available)

Table 3-12. Definitive Ephemeris Format Definition

LANDSAT 5 MISSION OPERATIONS CENTER (LMOC)

Destination: LAM

Mailing Address: LANDSAT 5
4300 Forbes Blvd.
Lanham, MD. 20706 USA

FAX Number: 001-301-577-7865

E-Mail Address: L5FOT@csc.com

Points of Contact

Area of Responsibility	Name	Number		Business Hours
Landsat Control Center	Flight Controller on-duty	phone: FAX: e-mail:	001-301-429-6611 001-301-577-7865 l5fot@csc.com	(Oct. - Apr.) 1215z - 0645z (Apr. - Oct.) 1115z - 0545z
Mission Scheduling:	Rob Wittig	phone: FAX: e-mail:	001-301-429-6617 001-301-577-7865 rwittig@csc.com	(Oct. - Apr.) 1300z - 2200z (Apr. - Oct.) 1200z - 2100z
Director, Operations	K.C. Leung	Phone: FAX: e-mail:	001-301-794-4059 001-301-794-8380 kleung@csc.com	(Oct. - Apr.) 1300z - 2200z (Apr. - Oct.) 1200z - 2100z

Table 3-13. L5 Points of Contact

Appendix A Acronyms

ASCII	American Standard Code for Information Interchange
ATTN	Attention
BSTAR	Drag-related parameter in the NORAD 2-line element message
CSC	Computer Sciences Corporation
DE	Definitive Ephemeris
deg, DEG.	Degree
DEST	Destination
DTG	Date-Time Group
FTP	File Transfer Protocol
GS	Ground Segment
ICD	Interface Control Document
ID	Identification
IGS	International Ground Station
IIRV	Improved Inter-Range Vector
LAM	Lanham, Maryland USA
LFO	L5 Flight Operations
L5	Landsat 5
Md.	Maryland
MOC	Mission Operations Center
NORAD	North American Air Defense
ORIG	Originator
R.A.	Right Ascension
REV	Revision
S/C	Spacecraft
SEQ	Sequence
SFBME	Short Form Brouwer Mean Element
SRVREQ	Service Request Message
SRVSCH	Service Schedule Message
TM	Thematic Mapper

USGS U.S. Geological Survey
UTC Coordinated Universal Time
z Zulu Time

References

The latest published version of these documents shall apply. They are available at:

<http://landsat7.usgs.gov/igsdocsI5.php>

USGS/EROS. LS-PD-20. USGS / LANDSAT 5 Downlink Authorization Policy.